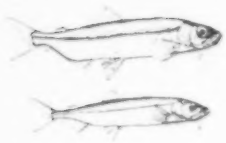


CAPELIN IN SUBAREA 2 + DIV. 3KL

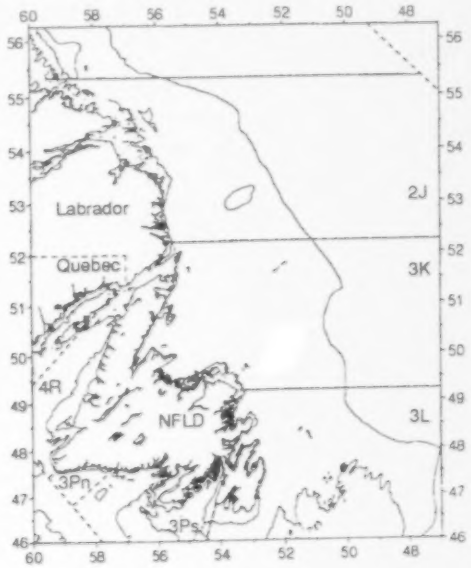
Background

Capelin is a small pelagic schooling species with major populations occurring in the Northwest Atlantic, in waters around Iceland, in the Barents Sea and in the northern Pacific. For several years, capelin in SA2 + Div. 3K and Div. 3L were treated as two stocks but, as a result of accumulated evidence, scientists recommended in 1992 that capelin in these areas be considered one stock complex.

Adult fish range in size from about 12 to 23 cm with males being larger than females. The spawning populations are composed of mainly three and four year old fish. The short life span and variable recruitment offers the potential for frequent and dramatic changes in mature biomass.

Juvenile capelin of the SA2 + Div. 3KL stock can be found both in major bays and in offshore waters although the northern Grand Bank and Northeast Newfoundland Shelf are thought to be major nursery areas. At maturity, schools of adults migrate inshore to spawn on Newfoundland beaches during June and July. After the eggs have hatched, the larvae exit the beach gravel and most are carried out of the bays rapidly by surface currents.

Capelin are preyed upon by many predators including seals, whales, cod, Greenland halibut, salmon and seabirds. They are considered to be a key element in the food chain. This prominent position in the ecosystem has resulted in a conservative approach to their management. In the late 1970's, scientists recommended that no more than 10% of the projected mature biomass be removed annually in a commercial fishery.



The Fishery

Historically, a small domestic fishery (annual harvest estimated at about 25,000 t) for capelin on the Newfoundland spawning beaches existed to provide food, bait and fertilizer. A directed foreign offshore fishery began in the early 1970's and was closed in Div. 3L and in Div. 2J3K beginning in 1979 and 1992, respectively. During the late 1970's, an inshore fishery for roe capelin began. Throughout the 1980's, the inshore fishery usually started by mid-June in the south and finished about mid-July in the north.

The main gear types in the inshore fishery are traps, purse seines and, to a lesser extent, beach seines. The primary market is for frozen roe-bearing female capelin in Japan. This market is limited and the demand for quality is high. Failure to meet quality standards results in

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discarding. Most discarding is believed to occur after the fish are landed and since the TAC is applied to the landings, these discards are accounted for in the application of the TAC.

Inshore catches during the 1980's were usually about the same as the TAC, largely because the TAC was based on expected market demand. Catches in the 1990's have been more variable when compared to the TAC. This was especially evident in Div. 3L in 1992 and throughout the area in 1994 when catches were well below the TAC's.

In 1995, the fishery did not open. In 1994 and 1995, the average size of female capelin was too small to meet the management plan size criterion of 50 count/kg (sea run). A summary of catches and TACs (tons x 10^{-3}) since 1990 is given below.

	1990	1991	1992	1993	1994	1995	1996
SA2 + Div. 3K							
Offshore							
TAC	71	57	0	0	0	0	-
Nominal catch	57	0.5	0	0	0	0	-
Inshore							
TAC	29	29	17	11.4	11.5	11.5	9.7
Nominal catch	33	20	18	13a	<1a	<1a	8a
Div. 3L							
TAC	56	56	19.3	21	21	22	18.3
Nominal catch	48	22	3	23a	1a	1a	16a
SA2 + Div. 3KL							
Total nominal catch	138	42.5	21	36	1	1	24

a provisional

In 1996, the management plan did not include a size criterion, thus, a fishery was not prohibited due to individual fish size. Because the average size of females in the 1996 fishery was larger than the average size of females spawning in 1995, capelin were marketable in 1996. Preliminary landings reported were 24,000 tons including discards compared to a market-based quota allocation of 28,000 tons.

Since 1991, the fishery has been delayed by up to four weeks because of the late arrival of capelin, which has been linked with unusually cold water temperatures. In 1996, capelin spawning was only slightly later than normal.

Multispecies Considerations

Harp seals are estimated to have consumed about 800,000 tons of capelin in Div. 2J3KL in 1996. Puffins are estimated to consume about 12,000 tons during the breeding season alone. Consumption estimates for puffins outside the breeding season, for other seabirds and indeed for many other predators are not available for recent years. Previous estimates for cod consumption indicated that during the early 1980's, cod were consuming 1 to 3 million tons of capelin annually. During the same time period, a minimum of 100,000-200,000 tons of capelin were estimated to have been consumed by Greenland halibut. Although consumption estimates can vary depending on the assumptions underlying the calculations, they serve to illustrate sustenance provided to predators. Because the consumption estimates are calculated using predator abundance, they will vary with the marked changes in abundance of the various predators over time.

Resource Status

In the evaluation of resource status, several indicators were combined in a mathematical model which averaged the information from the different indicators and provided relative estimates of yearclass strength. The indicators used in the model were:

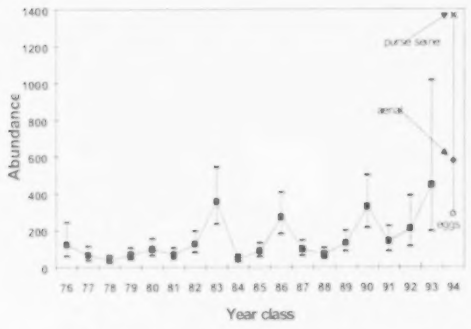
1) aerial survey index 1982-96
2) purse seine catch rate index 1981-96
3) trap catch rate index 1981-93
4) groundfish 3L fall bycatch 1985-94
5) groundfish 2J3K fall bycatch 1985-94
6) Russian 2J3K fall commercial catch rate index 1972-91

7) egg deposition index 1990-96

The aerial survey, the egg deposition index and purse seine catch rate provided the only information on the 1994 yearclass and the 1996 mature biomass in this formulation of the mathematical model. The aerial survey index was the highest in the series, the egg deposition was the second highest in the series and the purse seine catch rate was approximately equal to the average. A calibrated trap catch rate index for 1996 was not used because changes in management practices resulted in fishing patterns and trap catch rates which were not comparable to previous years.

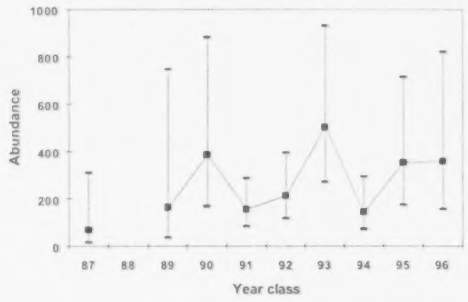
Results from the model indicate that the 1983 and 1986 yearclasses were strong as were the 1990 to 1992 yearclasses. The 1993 yearclass appears strong although the 95% confidence intervals are large. Estimates of the 1994 yearclass from the three data sources exhibit a wide range and therefore there is great uncertainty about the abundance of this yearclass from this analysis. However, even the lowest estimate (from the egg deposition index) would suggest that this yearclass is not weak.

Standardized Cohort Estimates



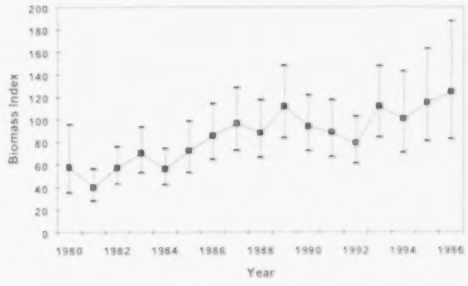
A separate analysis of results from surveys for larvae and one-year-olds shows the same trends in yearclasses up to 1993. The 1994 yearclass appears weaker in this analysis. The 1995 and 1996 yearclasses appear strong.

Standardized Recruitment Index



A separate mathematical model provided trends in mature biomass. The annual biomass index was estimated to be at an historically high level during the 1993-96 period but not dramatically higher than during the mid to late 1980's when strong yearclasses contributed to the population.

Standardized Annual Mature Biomass



The scientific assessment of the capelin stock is more optimistic than the results from an opinion survey of capelin fixed gear fishers who thought the 1996 abundance about average. In a similar survey last year, fishers felt the 1995 capelin abundance was low.

Sources of Uncertainty

The uncertainties for the 1993 yearclass as estimated from the model are large (in statistical terms, these are called 95%

confidence intervals and in the figures are the vertical bars). For the 1994 yearclass, estimates derived for each index are shown separately, rather than combined, to illustrate the wide range of estimates for this yearclass. The 95% confidence intervals are not plotted for the 1994 yearclass.

Assigning ages to individual fish and thereby identifying fish as belonging to a specific yearclass, is done by counting annual growth rings in the otoliths or "ear-bones". During cold periods, the rings will often occur closer together making age determination more difficult. This has occurred during the early 1990's, coincident with the colder temperatures and has added more uncertainty to the identification of yearclasses.

Stock status has been difficult to determine in recent years because of the divergence between inshore indices and offshore acoustic surveys. This divergence continued in 1996 with the low spring acoustic estimate in Div. 3KL. For the acoustic surveys, there is evidence to suggest that poor acoustic detectability, when capelin are dispersed, and unusual geographic distributions in recent years may be contributing to abundance estimates that are lower than the true population size and not comparable to the estimates from the 1980's.
On the other hand, indices of abundance for mature capelin inshore have remained at levels higher than would have been expected from the acoustic surveys. Furthermore, results from surveys that monitor capelin abundance as larvae and one-year-olds are in general agreement with the estimates of relative yearclass strength from the inshore indices during 1987-93. The divergence between low acoustic estimates and higher estimates from other sources created uncertainty about the reliability of the estimates. However, because the wealth of information did not support the low acoustic estimates, the latter were not included in the formulation of the mathematical model described above.

Outlook for 1997

The 1993 and 1994 yearclasses are expected to be major contributors to the 1997 spawning stock. The results from this assessment show that the 1993 yearclass is strong. The estimates for the 1994 yearclass span a wide range, however, even the lowest estimate would indicate that it is at least as strong as the 1991 yearclass and therefore, larger than many yearclasses in the timeseries. No absolute estimates of these yearclasses presently are available. However, during 1982-89, catches in Div. 3L averaged only 4.3% of the mature biomass projected from the 3L acoustic survey. This corresponded to an annual average catch in Div. 3L of 35,000 tons. During the same period, inshore catches averaged 12,000 tons in SA2 + Div. 3K. The total catches in SA2 + Div. 3KL during the 1980's were supported by yearclasses no stronger than the 1993 and 1994 yearclasses. Thus, based on this comparison, the TAC of about 28,000 tons in SA2 + Div. 3KL in the tentative management plan would be less than 10% of the expected mature biomass in 1997.

Average female size in the 1996 fishery was approximately equal to that predicted from size observed in fall surveys in 1995. The average size of mature females in 1996 was smaller than that observed during the 1980's but larger than that observed during the early 1990's. Based on historical trends in size of both immature females in the previous spring and maturing females in the previous fall with size inshore the following year, capelin in the 1997 spawning stock will be comparable in size to the historical average.

For More Information

Research Document: Anonymous. 1997. Capelin in SA2 + Div. 3KL. CSAS Res. Doc. 97/29.

Contact:
Jim Carscadden
Tele.(709)772-5541
Fax.(709)772-4105
email: Carscadden@athena.nwafc.nf.ca

This report is available:

Science Branch
Dept. of Fisheries and Oceans
Newfoundland Region
P.O. Box 5667
St. John's NF A1C 5X1
(709) 772-4355
e-mail address: gperry@athena.nwafc.nf.ca